REMARKS

Summary of Office Action

Claims 10-18 are pending. These claims have been rejected under 35 U.S.C. §103(a) as being obvious from Daniels et al. U.S. Patent No. 5,412,913 ("Daniels").

Applicants' Reply

For brevity, applicants do not reproduce, but incorporate by reference herein the Remarks presented in earlier Replies. Applicants respectfully request consideration of those remarks in addition to the ones made herein.

Applicants have amended claims 10 and 11, for clarity, by rewriting the equations therein using temperature dependent tensile strength parameters TS and TSt. No new matter is added. The recited equations are readily derived, for example, by substituting $b\tau = TS/\sqrt{3}$, $b\tau t = TSt/\sqrt{3}$ and $No = (0.675 \times \sqrt{3} \times \mu/\nu)$ as appropriate in equation 1 ¶ [0051] and equation 2 ¶ [00057].

Applicants note that claim 10 requires "the ratio of a effective cross sectional area of a bolt thread (bAs) to a correctional area of bolt shank (bAs)" to be grater than or equal to a critical value 0.8, and "the ratio of bolt tensile strength at 650 C (TSt) to the bolt tensile strength at room temperature (TS)" to be greater than or equal to a critical value $(0.675 \times \sqrt{3} \times \mu/\nu) \times bAe/bAs$.

Applicants submit that Daniels does not show, teach, or suggest the elements of claim 10 (and dependent claims 11-18), which require "ultra-high-strength bolts that provide additional fire resistance to the connection structure".

Daniels describes a joinder system and method, which allows individual vertical columns or prefabricated module assemblies to be quickly joined or assembled. (See Daniels,

Abstract, FIGS. 1-5, etc.). Daniels is only concerned with and describes quick self aligning joints with telescopic splicing or shimming plates. (See e.g., col. 3 line 28 - col. 4 line 61, claim 1, etc.).

As correctly noted by the Examiner, Daniels is not concerned with fire protection. (See Office Action page 2). However, the Examiner mistakenly states that Daniels discloses "a **high-strength** bolt connection." Applicants again note that Daniels relates to splice plates and self alignment of joints. Daniels use of bolts is only incidental. Daniels describes at most conventional bolts 45 and nuts with no indication or interest in the properties of the bolts, particularly properties for fire resistance. (See Daniels col. 7 lines 23-39). Daniels does not recognize that the strength of the bolts is an issue for fire resistance. Daniels makes no mention of and does not suggest consideration of the temperature dependent properties of the bolts (or even his entire structure) for any fire protection. In particular, applicants respectfully submit that Daniels does not show, teach, or suggest the elements of claim 10.

Applicants respectfully submit that the Examiner has improperly rejected claim 10 (as being obvious from Daniels) without establishing a prima facie case of obviousness. (See Office Action, pages 2-3).

To establish a prima facie case of obviousness under §103(a), according to MPEP § 2143, three basic criteria must be met: (1) some suggestion or motivation to modify Daniels; (2) a reasonable expectation of success; and (3) a teaching or suggestion of all the elements of claims 10-18.

Applicants also respectfully note, according to MPEP § 2124 "[t]he initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done. 'To support the conclusion that the claimed invention is directed to obvious subject

matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.' Ex parte Clapp, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985)."

The §103(a) rejections of claims 10-18 in the Office Action do not address or satisfy any of the three criteria required to establish a prima facie case of obviousness. (See Office Action pages 2-3).

For example, there is no teaching or suggestion in Daniels of ultra-high-strength bolts that provide additional fire resistance to the connection structure, each of the bolts having a bolt tensile strength of at least 1200 N/mm2 at a room temperature, wherein the ratio of a effective cross-sectional area of a bolt thread (bAs) to a correctional area of bolt shank (bAs) is $\geq$ 0.8 , and wherein the ratio of bolt tensile strength at 650 C (TSt) to the bolt tensile strength at room temperature (TS) satisfies the inequality recited in claim 10. For at least this reason, the Office Action fails to make a prima facie case of obviousness.

Applicants also note that there is no suggestion in Daniels (or otherwise) directed to person in the art for modifying the conventional bolts of Daniels to arrive at applicants' invention for additional fire protection. Applicants note that the Office Action improperly uses hindsight based on applicants' disclosure to ascribe the claimed bolt properties to Daniels.

Applicants also note that the Office Action mischaracterizes the claims as reciting functional properties. (See office Action page 3 last paragraph). Claims 10-18 recite "structural" properties of bolts and not functional properties. The claimed structural property is described by an equation (e.g., claim 10), which establishes acceptable structural property range for bolts and not their function of holding the overall structure together without shear or fracture.

Applicants further note that the claimed ranges are not mere design choices as alleged by the Examiner, but a result of deliberate investigations by the applicants of the critical aspects of bolt structure and fire failure. As previously noted, and as is described in the specification, applicants have identified that the high temperature failure of a bolted connection structure is critically dependent not only on the tensile strength of the bolt, but also on the shear fracture properties of the small portion of the bolt shaft diameter.

In order to secure the fire resistance of the bolted connection structure, it is necessary not only to enhance the tensile strength of the bolt at high temperature, but also to secure shear strength of the bolt at high temperature. In other words, it is necessary not only to select bolt materials having higher tensile strength at high temperature, but also, according to the invention, to enlarge the bolt shape (i.e., ratio of shaft diameter of the bolt), which contributes to shear strength at high temperature. By the invention, based on the above mentioned investigations, the ratio of shaft diameter (bAe/bAs) of a fire resistant bolt should be set to be above the critical value of 0.8 or more. (Applicants note that for conventional bolts this ratio is less than 0.8, e.g., 0.781 for M16 and M24 bolts, 0.780 for M20 bolts, and 0.797 for M22 bolts).

Further, based on the applicants' findings that high fire resistance of the bolted connection structure depends both on structural factors such as tensile strength and shape of the bolt (ratio of shaft diameter), the ratio of tensile strength of the bolt at 650°C to that of at room temperature (TSt/TS) should greater than the critical value of $(0.675 \times \sqrt{3} \times \mu/\nu)$ times the ratio of the areas (bAe/bAs), as recited in claim 10.

For at least the foregoing reasons claim 10-18, Daniels does not show, teach, or suggest the elements of claim 10-18. Accordingly claims 10-18 are non-obvious and patentable over the cited art.

Conclusion

This application is now in condition for allowance. Reconsideration and prompt allowance of which are requested. If there are any remaining issues to be resolved, applicants respectfully request the Examiner to kindly contact the undersigned attorney by telephone for an interview.

Respectfully submitted,

By: _____

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